Forest Health Protection

Pacific Southwest Region
Northeastern California Shared Service Area

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To: District Ranger, Yuba River RD, Tahoe National Forest

Subject: Hazard Tree Mitigation by Treating Root Disease in Yuba Pass Campground (FHP Report NE23-04). (Lat 39.6156 Lon -120.4916)

Introduction: Last summer Tahoe NF, using service contracts, removed the red fir (RF) overstory in and around Yuba Pass Campground (YPCG) to control diseases that have been a problem for more than thirty years. From approximately 13 acres, one million board feet of RF timber was logged and decked; and one thousand tons of biomass was chipped and removed (see Figures 1 & 2)

Figure 1. 10/11/23:

Decked logs and biomass chipping.

RF mortality, like that found in the forest surrounding YPCG, is evident on the mountain in the background; pictured mortality is similar to the mortality occurring in YPCG for decades.

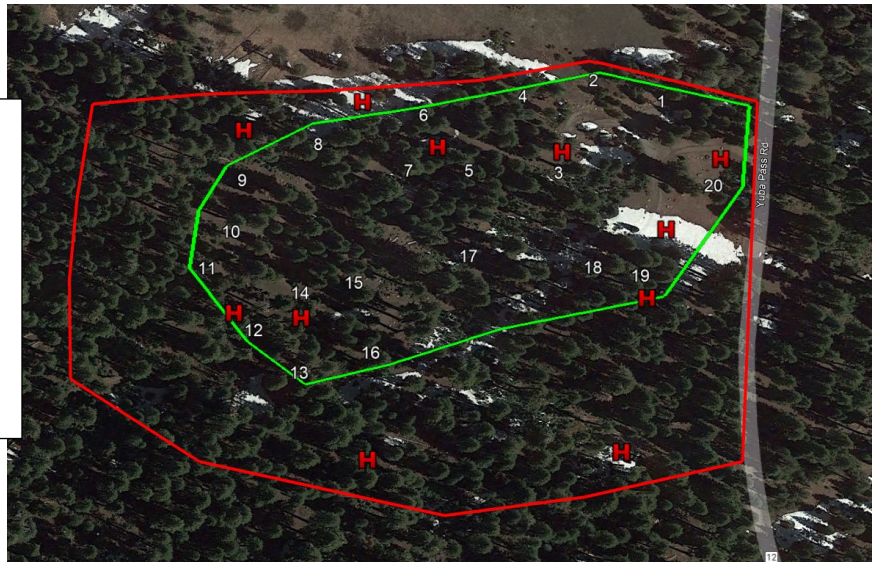

Figure 2.

Red polygon is the approximate 13 acre logged area.

YPCG is the green polygon with numbered campsites.

Each red "H" represents some of the many newly-cut RF stumps found with possible HRD decay. Wood from some of these stumps is being analyzed by UC Berkeley for root disease.

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Background:
In 1998, Forest Health Protection (FHP) reported a Heterobasidion root disease (HRD) problem in the old growth RF in YPCG (FHP Evaluation #98-14). Soon after, Tahoe NF used commercial timber sales to removed many large declining RF trees in the campground which were suspected of being hazardous because of HRD decay in the roots and stumps.

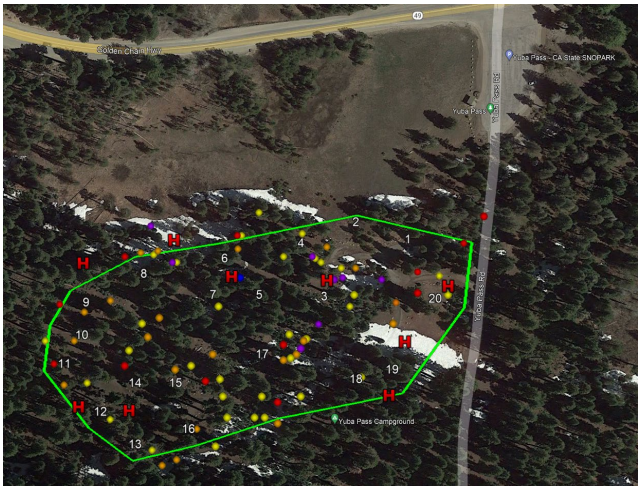
In 2019, FHP reported that: "*Root diseased red fir stands at Yuba Pass Campground contain numerous hazard trees that should be removed*." (FHP Evaluation #19-01).

In 2023, Tahoe NF addressed the ongoing hazard tree problem in YPCG by removing all the overstory RF in and within striking distance of campsites (Figure 3). Some diseases involved were: RF HRD; Armillaria root disease; RF dwarf mistletoe (*Arceuthobium abietinum* f.sp. *magnificae*); and Cytospora canker (*Cytospora abietis*).

Figure 3. YPCG after logging; looking west from campsite 5. The large RF stump is discolored with possible incipient decay.

Root Disease Findings:
After logging, the campground was surveyed for old stumps. Over one hundred fifty stumps, cut between 1980 and 2000, were mapped (Figure 4). The number of old stumps present suggests that RF decline and mortality has been a problem for at least three decades in YPCG.

Figure 4. Different colors of dots represent various numbers of the 150 old stumps near YPCG campsites that were cut between 1980 and 2000.



Almost 600 freshly cut RF stumps were examined for decay. Stumps with symtomatic HRD decay (Figures 5,6,7,8), Armillaria decay and unidentified decays resulting from old basal wounds (Figure 5) were found and tallied. Even though much of the decay did not appear serious (Figures 7 & 8), decay always worsens in time; and the amount of associated decay weakening the roots is impossible to know. Figure 8 shows various decays seen in two log decks. A few large RF trees in or near YPCG had decayed roots and boles from unknown disease(s) and were uprooted or snapped off by wind; indicating that future failures are likely. YPCG is located at the crest of the Sierra Nevada Mountains where strong winds occur often.

Figure 5. Unidentified decay from a basal wound and possible decay from HRD.

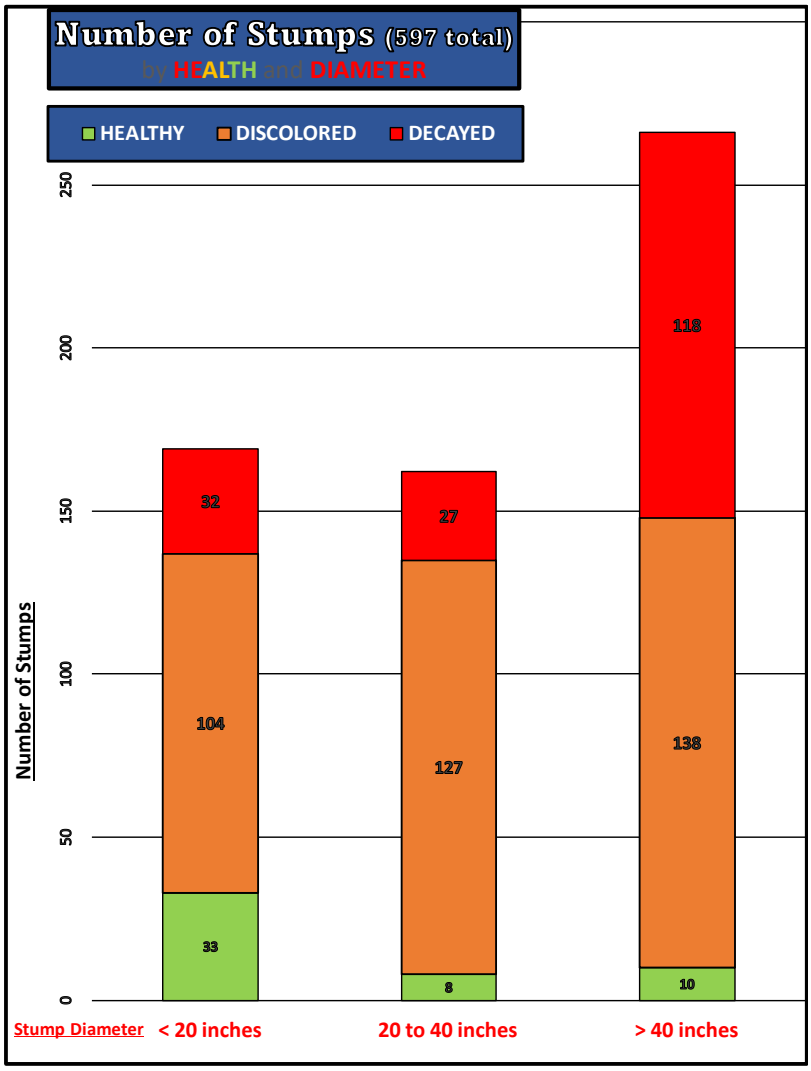
Figure 6. Probable HRD decay and incipient decay

Figure 7. Probable incipient HRD decay (L&R) in butt logs and HRD decay (L)

Figure 8. Probable HRD decay, incipient decay and unknown decay in decked logs

Figure 9 is a bar graph summary of the decay and incipient decay found in 597 freshly cut RF stumps. The stumps were mostly large (45%: greater than 40" in diameter; 27%: 20" to 40"). About half of the decayed RF stumps (half of the red bars) had symtomatic HRD decay (i.e. white rot and/or hollow stumps). The other half had unknown decays originating from basal wounds. Some of the later could have been HRD. Two decaying RF stumps were found with *Armillaria* spp. rhizomorphs. Wood from ten of the RF stumps shown in Figure 2 was sent to the pathology lab at UC, Berkeley to confirm HRD and/or Armillaria root disease.

Figure 9. Decay found in 597 tallied freshly cut RF stumps: 30% decayed; 62% possible incipient HRD decay; 8% healthy



Dwarf Mistletoe Findings:
RF dwarf mistletoe (Figure 10) and branches killed by Cytospora were present in the crowns of the logged RF trees. A few of the remaining RF regeneration trees were observed to be infected with dwarf mistletoe (Figure 11). Removing dwarf mistletoe-infected RF regen or pruning infected branches will improve the health and longevity of these trees and future RF regeneration. In order to sanitize the dwarf mistletoe from the RF regeneration, at least two treatments, five years apart, will be required to capture latent dwarf mistletoe infections that will be hidden at the time of the first treatment.

Figure 10. Dwarf mistletoe in logging slash.

Figure 11. Dwarf mistletoe in RF regen

Discussion:
For many decades YPCG was known to have a disease problem which resulted in ongoing hazardous RF tree removals. In 1998 and before, problem RF trees were logged in conjunction with at least three nearby timber sales. Last summer with service contracts, Tahoe NF sought to make YPCG safer and control RF diseases by removing RF overstory trees that were within striking distance of campsites.

This action should successfully control most RF root disease. However, a few large potentially dangerous RF and lodgepole pine trees remain just outside the logged area. During strong winds, a few of the large RF edge trees may have root disease or bole decay and could uproot or snap off and fall dangerously close to campsites. In addition, a few tall RF and lodgepole pine trees remain in YPCG and are no longer protected from wind by overstory trees. Strong winds often happen at ridgetop locations, like YPCG. Fortunately, high winds mostly occur in winter, when YPCG is not occupied.

For future root disease control projects in campgrounds, it is recommended to remove more tall trees within striking distance of campsites because these trees will no longer be protected from wind after most overstory trees are gone. A large timber sale in conjunction with removing YPCG hazard trees may have accomplished the same results seen at YPCG more economically than service contracts by treating diseases in a much larger forest. Furthermore, a timber sale contract for treating YPCG may have offered more flexibility to remove newly identified hazard trees.

The work at YPCG was accomplished with almost no damage to the facilities. This work left hundreds of stumps which can be removed or left to decay naturally (Figure 12). New RF seedlings will eventually regenerate and grow in the logged area long after HRD is no longer a problem. There now is an option to remove remaining hazard trees in and around the treated area with a landscape level forest health timber sale aimed at controlling more HRD. In spite of any shortfalls of this project, Tahoe NF should be commended for effectively using newly available funds to mitigate a long standing RF hazard tree problem in YPCG.

Figure 11. Twenty-five-year-old decaying RF stumps

Please contact Bill Woodruff at 530-249-7990 with questions or for help with future YPCG work.

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Appendix: Pest Biologies

Heterobasidion root disease

Heterobasidion spp. is a fungus that attacks a wide variety of woody plants. All western conifer species are susceptible. Madrone (*Arbutus menziesii*), and a few brush species (*Arctostaphylos spp.* and *Artemisia tridentata*) are occasional hosts. Other hardwood species are apparently not infected. The disease has been reported on all National Forests in California, with incidence particularly high on true fir in northern California, in the eastside pine type forests, and in southern California recreation areas.

Heterobasidion root disease is one of the most important conifer diseases in US Forest Service Region 5, California. Current estimates are that the disease infests about 2 million acres of commercial forestland in California, resulting in an annual volume loss of 19 million cubic feet. Other potential impacts of the disease include increased susceptibility of infected trees to attack by bark beetles, mortality of infected trees presently on the site, the loss of the site for future production, and depletion of vegetative cover and increased probability of tree failure and hazard in recreation areas.

During periods favorable to the fungus, fruiting bodies (conks) form in decayed stumps, under the bark of dead trees, or under the duff at the root collar. New infection centers are initiated when airborne spores produced by the conks land and grow on freshly cut stump surfaces. Infection in true fir may also occur through fire and mechanical wounds, or occasionally, through roots of stumps in the absence of surface colonization. From the infected stump surface, the fungus grows down into the roots and then spreads via root-to-root contact to adjacent live trees, resulting in the formation of large disease centers. These infection centers may continue to enlarge until they reach barriers, such as openings in the stand or groups of resistant plants. In pines, the fungus grows through root cambial tissue to the root crown where it girdles and kills the tree. In true fir and other non-resinous species, the fungus sometimes kills trees, but more frequently is confined to the heartwood and inner sapwood of the larger roots. It then eventually extends into the heartwood of the lower trunk and causes chronic decay and growth loss.

Heterobasidion root disease in western North America is caused by two species: *Heterobasidion occidentale* and *H. irregulare*. These two species of *Heterobasidion* have major differences in host specificity. *H. irregulare* is pathogenic on ponderosa pine, Jeffrey pine, sugar pine, Coulter pine, incense cedar, western juniper, pinyon, and manzanita. *H. occidentale* is pathogenic on true fir, spruce, and giant sequoia. This host specificity is not apparent in isolates from stumps; with *H. occidentale* being recovered from both pine and true fir stumps. These data suggest that infection of host trees is specific, but saprophytic colonization of stumps is not. The fungus may survive in infected roots or stumps for many years. Young conifers established near these stumps often die shortly after their roots contact infected roots in the soil.

Dwarf mistletoe

Dwarf mistletoes (*Arceuthobium* spp.) are parasitic, flowering plants that can only survive on living conifers in the Pinaceae. They obtain most of their nutrients and all of their water and minerals from their hosts.

Dwarf mistletoes spread by means of seed. In the fall the fruit ripen and fall from the aerial shoots. The seeds are forcibly discharged. The seed is covered with a sticky substance and adheres to whatever it contacts. When a seed lands in a host tree crown, it usually sticks to a needle or twig, where it remains throughout the winter. The following spring the seed germinates and penetrates the twig at the base of the needle. For the next 2-4 years, the parasite grows within the host tissues, developing a root-like system within the inner bark and outer sapwood, and causing the twig or branch to swell. Aerial shoots then develop and bear seed in another 2-4 years.

Dispersal of dwarf mistletoe seeds is limited to the distance the seeds travel after being discharged. From overstory to understory, this is usually 20 to 60 feet, but wind may carry them as far as 100 feet from the source. A rule of thumb is that the seeds can travel a horizontal distance equal to the height of the highest plant in an infected tree. There is some evidence that long distance spread of dwarf mistletoe is occasionally vectored by birds and animals.

Vertical spread within tree crowns of most dwarf mistletoes is limited to less than one foot per year because of foliage density. Because of the thin crowns of gray pine, however, the vertical rate of spread has been measured as being greater than 2 feet per year. This rate of spread equaled or exceeded the rate of height growth of infected trees.

Dwarf mistletoes are easy to identify because they are generally exposed to view within a tree's crown. Signs of infection include the yellow green to orange mistletoe plants, basal cups on a branch or stem where the plants were attached and detached plants on the ground beneath an infected tree. Symptoms include spindle-shaped branch swellings, witches' brooms in the lower crown, and bole swellings.